HALEAKALA NATIONAL PARK CRATER DISTRICT RESOURCES BASIC INVENTORY: THE LICHEN FLORA

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INTRODUCTION

The lichens of Haleakala have received scant attention in the past. The only comprehensive collection prior to the Resources Basic Inventory was by Skottsberg during the Hawaiian Bog Survey in 1938. This collection was studied by A. H. Magnusson and forms a significant element of his Catalogue of the Hawaiian Lichens. A few other botanists have collected in the Crater including the Abbe Faurie, J. F. Rock, and O. Degener. However, none of these collectors were specialists in lichens; their collections were incidental to their other interests, mostly flowering plants.

This report is a preliminary investigation of the lichens of the Crater District of Haleakala National Park with notes on the principal lichen associations found in the area. Unfortunately, several groups are very inadequately understood from a taxonomic point of view and the omission of some of them seriously limits the reliability of a few of the assessments. This reservation is particularly true of the rock-inhabiting species at higher elevations. A significant number of species, about 25%, still await determination by specialists. In the majority of instances, their lack of response is the result of their own current uncertainty on these Hawaiian specimens. As further information becomes available the list will be updated and the ecological assessments revised.

WHAT ARE LICHENS?

Lichens are an obligate symbiotic association between a fungus and an alga. The association produces a plant which is uniquely different from that of either the fungus or alga growing alone. Perhaps the single most significant ecological feature of lichens is that they must undergo periodic dessication. If they are not allowed to dry out within a three or four day period they become moldy and die. Thus these plants are ideally suited to areas where water is not continuously available. One may think of deserts in this respect but many situations in more equable

climates experience alternating periods of wet and dry, for example, rock surfaces, leaves, tree trunks, and branches and even the surface of soil.

There are three basic growth forms in the lichens: crustose, foliose, and fruticose. Crustose species form a thin crust or film over the substratum. They are firmly attached to or embedded in the rock or bark. Foliose species lie flat on the substratum and are usually attached to it by hairs or rhizines. Foliose species can generally be separated from the substratum. Fruticose species are generally pendent or erect as in the familiar Usneas and British Soldier lichens. They are normally easily detached from the substratum.

It is generally true to say that the drier an area the more likely you will find crustose species, the wetter an area foliose and fruticose species. This generalization is as true on the microscale as it is on the macroscale. If you look at the twigs on the edge of a tree or bush you will normally find crustose species only. On the larger deeper shaded branches you will probably find foliose or fruticose species. The complicating factor to this generalization in Haleakala National Park is that many areas are frequently inundated in clouds which encourages the growth of the foliose and fruticose species in situations that would normally only support crustose species. On the other hand, in areas where rainfall and fog interception result in infrequent dessication, mosses and liverworts replace the lichens.

LICHEN ECOLOGY

All lichens in the Hawaiian Islands are presumed to be native or endemic. No exotic species are known, a situation which is likely to change in the near future because of the introduction of large numbers of plants from various regions of the world, e.g., orchids introduced to the Foster Botanic Gardens frequently have live lichens associated with them; Christmas trees from the Pacific Northwest nearly always have lichens on their trunks, especially Hypogymnia physodes. On the other hand, endemic and native species previously reported from Haleakala have not been located during this study. For example, the genus Umbilicaria is represented by three endemic species in the literature (Magnusson 1956). None of these species was found on the recent survey. Unfortunately, the type locality of one of these species, U. pacifica, is "at the top of Halemau (sic) Trail." Since the species has been collected from this area only, it may be assumed that it is now extinct or extremely rare in the area. The recent heavy pig impact will have made the former alternative more probable.

The lichen communities generally follow the flowering plant community distributions outlined in Whiteaker (1979) in his Vegetation Map of the Crater District of Haleakala National Park. However, two environmental variables modify the lichen community distributions so that they do not conform precisely to Whiteaker.

The diurnal frostline is of little significance in the distribution of rock-inhabiting lichens though it does have an impact on bark-inhabiting species because of the reduced availability of substrate. Lichens are capable of carrying out their life functions at much lower temperatures, even to freezing point, than flowering plants as long as there is sufficient moisture available. The other environmental variable, cloud inundation, extends the distribution of foliose and fruticose lichens beyond their expected distribution in mesic plant communities. Lichens are extremely efficient at absorbing water from air and can become quite wet in a short period of time when submerged in clouds. As a consequence, their growth and abundance are increased so much that the relative cloud cover can be fairly accurately mapped from the abundance of the epiphytic foliose lichens. For example, the eastern side of the Ko'olau Gap up to and beyond Pu'u Mamane is more frequently immersed in cloud than the western or central portions of the Gap.

Rock Communities

The lichen communities on rock are probably the least disturbed or altered in the study area. A few species have disappeared, for example, Umbilicaria pacifica, and the abundance of others may have been changed by habitat alteration. By and large, the community structure is probably the same now as it was prior to the impact of western man.

At the top of the mountain and in other areas which are predominantly devoid of vegetation, the rocks are colonized by a community in which Acarospora and Lecidea are dominant with occasional specimens of Caloplaca, Candelariella, and Rhizocarpon geographicum. Only the stable rocks and boulders are colonized; the loose cinder is too frequently disturbed by wind and rain for lichens to become established. Even on the rocks the lichens are always in very protected situations where the microenvironmental conditions offer some relief from the rigorous climate of the area. With decreasing elevation, the lichens are found in more exposed situations with increasing frequency and other species, for example, Stereocaulon vulcani and Placopsis gelida begin to appear in the community.

The lichens in this harsh environment do not grow very rapidly. Colony sizes are always small. The activity of lichens as primary colonizers in such situations is very low. Consequently, the rate at which they decompose the rock is low. Rain and other edaphic factors are probably more important in soil formation than are the lichens. At lower elevations or where moisture is more abundant, for example, the summit of Kuiki, the lichens probably play a significant role in soil formation.

Where moisture from cloud or rainwater is more abundant, the lichen communities on rock are more luxuriant in terms of both biomass and species diversity. The species of the genus Stereocaulon show an interesting series of communities which are

correlated with the amount and physical phase of the available water, as well as the age of the rock on which they are growing.

Stereocaulon vulcani, the primary colonizer of most lava flows in Hawai'i, characteristically grows where the annual rainfall is above 30 inches a year. Though one would expect to find it at the summit which supposedly receives this amount of rain each year, it is extremely rare and very poorly developed there. Its near absence is probably because most of the rain comes in two or three major kona storms each year. It is found throughout the rest of the Crater District but below 6000 feet its distribution is regulated by the growth of other organisms. The occurrence of this species in any appreciable quantity below 6000 feet is generally a good indication of the recent disturbance of the community.

Stereocaulon octomerellum grows on large boulders in the high rainfall area of the eastern side of the Kaupo Gap. It is normally found only on well-weathered, exposed rocks.

Stereocaulon ramulosum has an almost intermediate ecological position between the above two species. It favours environments in which cloud inundation is frequent. The height and fertility of the plants is indicative of the frequency of the cloud cover, the lower stature and infertile specimens indicating drier, harsher conditions.

Litter Communities

Where plant litter accumulates and areas where the humus content of the soil is high, the endemic Cladonia leiodea is dominant. The species is not tolerant of shading so it is characteristic of the open scrub communities. The luxuriance and colony size of the plants are an indication of the moisture regime of the area. The largest specimens are found in the wetter areas. The plant is particularly sensitive to mechanical disturbance and may serve as an indicator of past pig activity when absent from an area in which it should logically appear.

A rather unusual litter community occurs under the dead but still standing leaves between Deschampsia clumps. All of the species are very attenuated and none are fertile which is probably due to the suboptimal levels of light filtering down between the leaves. Pseudocyphellaria crocata, Sticta weigelii, Peltigera polydactyla and Cladonia scabriuscula are the most common species in this situation. I know of no similar community type adapted to such low light intensities.

Leaf Communities

In the gullies behind Paliku a fragmentary lichen community is found on the leaves of Pelea. Two species are present and represent the upper elevational limit of a specialized community normally found below 1000 feet. Their occurrence in this highly

protected environment illustrates the unusual nature of these gullies.

Bark Communities

The complex chemical nature of bark results in unique lichen communities on each tree or shrub species. Since chemical and physical surface characteristics change with the age of the bark, the associated lichen communities also change. Thus the lichen community on twigs will be different from that on the trunk. For example, the twigs and branches of mamane are colonized by Ochrolechia pallescens, Hypotrachyna sinuosa, and species of Candelaria, Buellia, Rinodina, and Lecanora, whereas the trunk has Parmelia dominicana, Pannaria rubiginosa, and Heterodermia speciosa. Every other tree and shrub has its own spectrum of species. Consequently, it is extremely difficult to describe the general distribution of bark-inhabiting species of lichens in any meaningful manner. Any attempt to do so is beyond the scope of this study which was not designed with this type of analysis in mind.

The distribution of Usnea and Alectoria on pukiawe and 'ohelo closely parallels the areas inundated by cloud for significant periods. Usnea is found where clouds probably cover the area at least half the days of the year whereas Alectoria smithii occurs in areas where the cloud cover is significantly less.

RECOMMENDATIONS

There are no formally designated threatened or endangered lichens. That does not mean that there are no rare lichens. Even if they were to be listed there would be very little that could be done to promote the species other than habitat protection and conservation. As with many other groups studied during this survey, the removal of the feral herbivores would be a significant management action to preserve the lichen communities in the Park.

LITERATURE CITED

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